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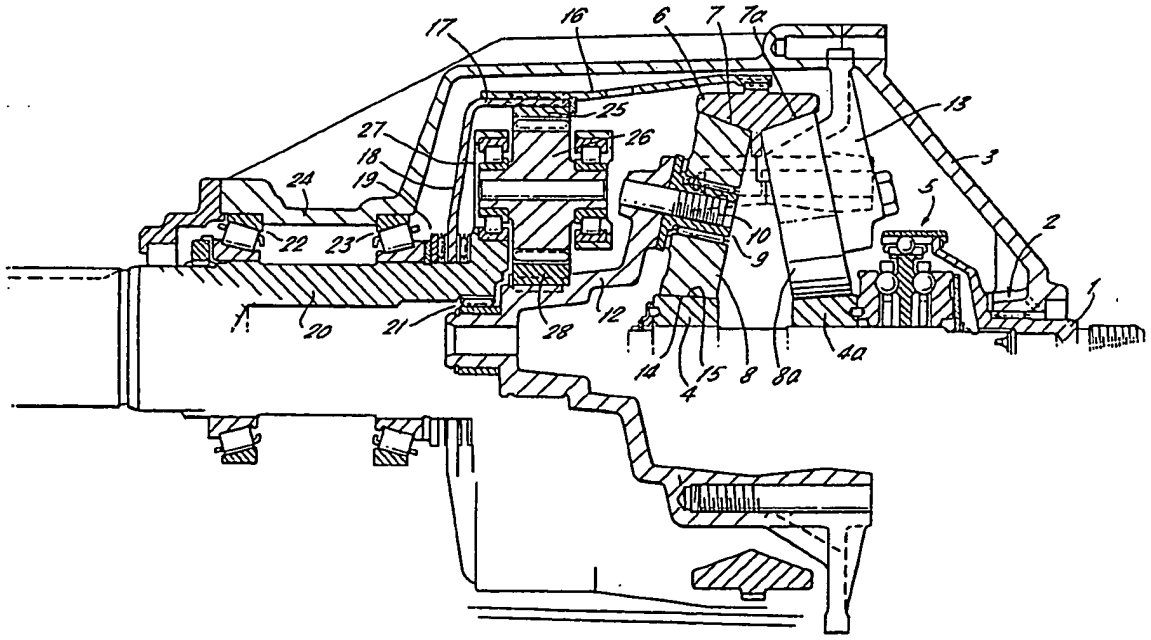
(58) Field of search
F2Q
Selected US specifications from IPC sub-class F16H

(54) Roller type friction drive system

(57) A roller type friction drive system comprises a frustoconical central roller 4 coupled to a frustoconical annulus 6 by way of a set of frustoconical rollers 8 each engaging the central roller and the annulus. The generatrices of the engagement surfaces of the rollers and the annulus intersect at a common point on the axis of the central roller. The rollers 8 are rotatably mounted on a fixed spider or carrier 12. The roller 4 is carried by an input shaft 1 which additionally carries a second roller 4*a* having an oppositely tapering surface and associated with a second set of rollers 8*a* and surrounding frustoconical ring surface 7*a*. The output from annulus 6 may provide the input to a second epicyclic gear stage comprising an internally toothed ring gear 25, planet gears 26 and a fixed sun 28. An output shaft 20 is connected to the planet carrier 27.



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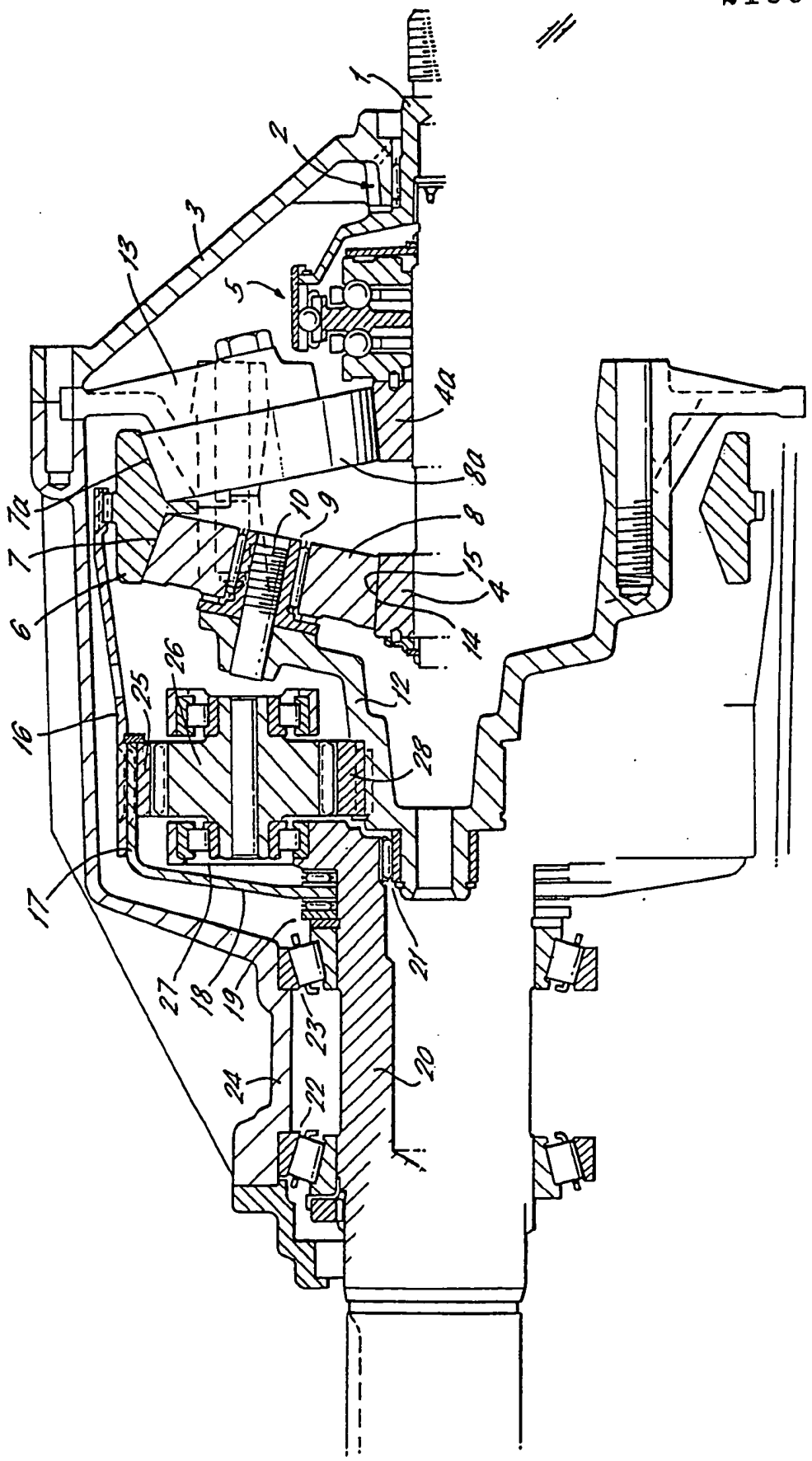
The drawing originally filed was informal and the print here reproduced is taken from a later filed formal copy.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SPECIFICATION

Roller drive system

The present invention relates to a roller drive system and to such a system in combination with epicyclic gearing.

It is known to provide a mechanical drive by oil film traction between rolling components either for variable speed or for fixed ratios. The object of the present invention is to provide a drive layout which may provide, for example, a speed increase or reduction of between 3 to 1 and 6 to 1 with a high efficiency and power density.

According to one aspect of the invention, there is provided a roller drive system in which a central bevelled roller is coupled to a bevelled annulus coaxial with the central roller by way of a set of bevelled rollers each engaging the central roller and the annulus, the generatrices of the engagement surfaces of the rollers and the ring intersecting in a common point on the axis of the central roller.

The said set of rollers may comprise rollers supported at evenly spaced locations about the central roller by a fixed reaction member.

According to a preferred embodiment of the invention there is a second central roller coaxial with and spaced axially from the first, the second central roller being coupled to a respective bevelled drive ring, which may be integral with the first, of the annulus by means of a respective second set of rollers, the second central roller being coupled to a common member with the first central roller, the bevelling of the second central roller and the respective set of rollers being in a sense opposite to that of the bevelling of the first central roller and its respective set of rollers and the two central rollers being urged in mutually opposite directions into contact with their respective said set of rollers.

The drive system characteristic of the present invention has a rolling geometry on a true bevel layout, there being no spin at the rolling contacts; the rollers in the set or sets work in parallel between a central roller and a single annulus and it is thereby possible to minimise the axial length and overall diameter of the drive system.

A further development of the present invention consists of the combination of a roller drive system as described above with at least one epicyclic gear train. In practice the limit for quiet gear operation is about 3000 r.p.m. and a roller drive system as described in the foregoing is adequate to reduce shaft speeds from, for example, of the order of 1200 r.p.m. down to below the upper limit for quiet gear operation. A higher reduction ratio involves greater torque and thus the end load, and hence size for a given life, of a roller drive begins to become excessive. Epicyclic gearing can take the increased torque efficiently in terms of power and volume and also comparatively quietly. Thus to obtain a torque multiplication ratio substantially greater than that conveniently available from the roller drive system as described in the foregoing, the said annulus may be connected to or constitute a first member of an epicyclic gear system of which a second member constitutes a reaction member and a third member constitutes an output member. For example, the said annulus may carry an annular gear in mesh with at least one and preferably a set of planet gears which are mounted on an output shaft member and the planets may be in mesh with a sun gear constituting the reaction member. A further stage of speed reduction may be provided by an additional epicyclic stage following or compounded with the said epicyclic gear system.

There follows a description of the present invention with reference to the accompanying drawing.

The embodiment shown in the drawing illustrates the incorporation in a single drive system of a roller drive which provides a first stage of speed reduction and an epicyclic gear stage driven from the output member of the roller drive.

The input to the roller drive system is in this embodiment constituted by an input shaft 1 which is supported by a bearing 2 relative to an end frame 3. The shaft 1 carries two spaced apart coaxial central rollers 4 and 4*a*, which are bevelled or tapered in opposite directions. The rollers 4 and 4*a* are loaded in opposite directions by means of a known form of load sharing mechanism 5.

The output member of the roller drive is an annulus 6 which in this embodiment has two bevelled ring surfaces 7 and 7*a*.

The roller 4 drives the ring 7 through a set, in this example three bevelled rollers 8 of which each is mounted by means of a bearing 9 on a stub shaft 10 extending from a respective arm 11 of a fixed spider 12. The roller 4*a* drives the ring 7*a* via a set, likewise in this example three bevelled rollers 8*a* which are each mounted on an extension arm 13 secured to the frame 3 which is also secured to the spider 12. The generatrices of the bevelled contact surface 14 of the rollers 4, contact surface 15 of the rollers 8 and the engagement surface of ring 7 intersect at a common point lying on the common axis of the input shaft 1 and the output annulus 6. The corresponding generatrices of the engagement surfaces of the roller 4*a*, rollers 8*a* and ring 7 lie on a respective common point on the axis of roller 4*a*. Moreover, the input shaft in effect drives the output member 6 by way of a plurality, i.e. six rollers working in parallel. This arrangement promotes the achievement of a high power density and excellent drive efficiency. It should be noted that there is true rolling and no spin at the rolling contacts. The centres of the intermediate rollers 8 and 8*a* are held against rotation about the axis of the input shaft. Since the rollers 4 and 4*a* are urged in opposite directions, in this embodiment towards each other, the roller drive system is self aligning.

If a step-up in speed is required, the shaft 1 would be the output member and the annulus 6 the input member.

The annulus 6 could be directly coupled to a final output drive member but in this embodiment of the invention in order to provide an additional stage of speed reduction the roller drive system is followed by an epicyclic gear stage. For this purpose the annulus 6 is mounted in a sleeve 16 which is secured

to an annular sleeve 17 extending peripherally from a disc 18 mounted for rotation under thrust loads from the planet tooth contacts by means of a bearing 19 with respect to an output shaft 20 which is supported by bearings 23 and 22 with respect to the casing 24. The boss of the spider 12 is held concentric by bearing 21.

The sleeve 17 carries an internally toothed ring 25 which is in mesh with a plurality of planet gears 26 supported in a planet carrier 27 secured to the shaft 20. The planets are in mesh with a sun gear 28 secured to the spider 12.

CLAIMS

1. A roller drive system in which a bevelled central roller is coupled to a bevelled annulus coaxial with the central roller by way of a set of bevelled rollers each engaging the central roller and the annulus, the generatrices of the engagement surfaces of the rollers and the respective engagement surface of the annulus intersecting at a common point on the axis of the central roller.

2. A roller drive system according to claim 1 in which the set of rollers is supported at evenly spaced locations about the central roller by a fixed reaction member.

3. A roller drive system according to claim 1 or claim 2 in which there is a second central roller coupled to a common rotary member with the first central roller, the second central roller being coupled to a respective bevelled drive surface of the annulus by means of a respective second set of rollers, the generatrices of the engagement surfaces of the second central roller and the rollers of the second set intersecting at a second point on said common axis, the bevelling of the respective sets of rollers being in opposite directions and the central rollers being urged in mutually opposite directions into contact with the rollers of the respective set.

4. A drive system comprising a roller drive system according to any foregoing claim, in combination with an epicyclic gear stage of which one member is connected to the said annulus, another member constitutes a reaction member and a third member comprises an output member for the epicyclic gear stage.

5. A system according to claim 4 wherein the said one member is a geared ring, and the output member comprises a set of planet gears meshing with the ring and mounted by means of a carrier for rotation with an output shaft, the reaction member comprising a sun gear in mesh with the said planet gears.

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